PATH MEDICAL SOLUTIONS

Technical specifications, manufacturer's data

Senti & Sentiero

Manufacturer

PATH medical GmbH
Landsberger Str. 63
D-82110 Germering
Germany

Email ✉ info@pathme.de
Telephone ✆ +49 89 800 765 02
Fax +49 89 800 765 03

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1. General device information

1.1 Device

- Device dimensions: 209 x 98 x 52 mm (Handheld), 150 x 210 x 45 mm (Desktop)
- Weight (incl. rechargeable battery pack): ca. 500 g (Handheld), ca. 475 g (Desktop)
- Display: 240 x 320 pixel; graphic LCD 3.5” (Handheld), 5.0” (Desktop)
- Features: resistive touch screen, real time-clock, piezoelectric sound generator
- Interfaces: RS232 (Senti), USB
- Output voltage and nominal impedance (headphone socket): 5 V_{pp}, 32 Ω
- Power consumption: max. 2 W

1.2 Power Supply, Rechargeable Battery

- Features: auto backlight control, automatic shutoff, double voltage control
- Rechargeable battery pack: 4.8 V NiMH (Handheld), 3.7 V Li-Ion (Desktop)
- Battery voltage limits for correct operation: 4.5 to 6.5 V (Handheld), 3.5 to 4.2 V (Desktop)
- Maximum operating time with fully charged batteries: ca. 6 to 8 hours (dependent on usage)
- Maximum charging cycles: 500 to 1000 (life time > 2 years for normal usage)
- Maximum charging time: ca. 2 hours (Handheld), ca. 8 hours (Desktop)
- Input rating of power supply units:
    - Sinpro MPU12: 100-240 V, AC, 47-63 Hz, 0.16-0.29 A
    - Sinpro MPU16: 100-240 V, AC, 47-63 Hz, 0.18-0.33 A
    - Friwo 7662M/12 (GPP6): 100-240 V, AC, 50-60 Hz, 0.15 A
- Output rating of power supply units: 9V, 1.2 A (Handheld); 9-12 V, 0.4 A (Desktop)

1.3 Storage, Transport, and Operating Conditions

Please keep the device and its accessories in the provided carrying case in order to protect the device and its accessories against external forces and environmental impacts. Extreme storage and operating conditions may result e.g. in breakage of the touch screen display (extremely low temperature) or in impairment of the device’s and transducer’s calibration.

Transport and storage conditions:

- Transport temperature: -20 to 60 °C (-4 to 140 °F)
- Storage temperature: 0 to 40 °C (32 to 104 °F)
- Relative air humidity: ≤ 90 % non-condensing
- Barometric pressure: 50 to 106 kPa

Operating conditions:

- Temperature: 10 to 40 °C (50 to 104 °F)
- Relative air humidity: 20 to 90 % non-condensing

- Barometric pressure: 60* to 106 kPa

* At locations where the normal air pressure is below 80 kPa (at altitudes of more than 2000 meters), it is recommended to recalibrate the transducers.

Warm-up time: before turning on the device, make sure that the device is warmed up to room temperature, i.e. the operating conditions must be fulfilled.

2. General transducer information

Please note that maximum levels given below for each test module may vary dependent on the individual transducer calibration.

The contact pressure for the different transducers is described in *Table 1*:

Headphone	Pressure [N]
Sennheiser HDA-280	5.0 ± 0.5
Sennheiser HDA-200	10.0
Sennheiser HDA-300	8.8 ± 0.5
Interacoustics DD-45	4.5 ± 0.5
Holmco PD-81	14.5
GN Otometrics ME-70	4.5 ± 0.5
RadioEar B-71	5.4 ± 0.5

Table 1: Contact pressure for different transducers

For information about RETSPL values please refer to the default levels provided with the PATH Service Tool. For information about damping features of the different headphones please refer to the transducer data sheet.

3. Test modules

For further information about the test modules please refer to the “How-To Manual”.

3.1 Multiple-Choice Auditory Graphical Interactive Check (MAGIC)

- Modes: Screening, Audio
- Frequencies: 0.25, 0.5, 1, 2, 3, 4, 6, 8 kHz; optional: 5 kHz instead of 6 kHz
- Stimulus levels (Screening): 20, 25, 30, 35, 40, 45, 60 dB HL
- Stimulus levels (Audio): -10 to max. 80 dB HL or transducer limits (see *Table 2*), step size: 5 dB
- Stimulus types: sine, warble tone (sine modulation, modulation depth = 10 %, f_{mod} = 4 Hz); single tone or two-tone presentation

Available transducers: Sennheiser HDA-280, Sennheiser HDA-200, Sennheiser HDA-300, Interacoustics DD-45, Holmco PD-81, GN ME-70, GN otoInsert, Etymotic Research ER-3A, RadioEar B-71

f [Hz]	250	500	1000	2000	3000	4000	5000	6000	8000
HDA-280	80	80	80	80	80	80	80	80	80
HDA-200	80	80	80	80	80	80	80	80	80
HDA-300	80	80	80	80	80	80	80	80	80
DD-45	80	80	80	80	80	80	80	80	80
PD-81	80	80	80	80	80	80	80	80	80
ME-70	80	80	80	80	80	80	80	80	80
otoInsert	80	80	80	80	80	80	80	80	70
ER-3A *10Ω*	80	80	80	80	80	80	80	80	75
ER-3A *50Ω*	80	80	80	80	80	80	80	80	80
B-71	35	50	60	60	60	50	45	40	35

Table 2: Maximum MAGIC sine stimulus levels for each transducer type

3.2 Pure-Tone Audiometry (PTA) Class 4

Screening audiometer class 4 according to IEC 60645-1

- Frequencies: 0.125, 0.25, 0.5, 0.75, 1, 1.5, 2, 3, 4, 5, 6 kHz
- Stimulus levels: 0 to max. 70 dB HL or transducer limits (see *Table 3*), step size: 5 dB
- Stimulus type: sine

Available transducers: Sennheiser HDA-280, Sennheiser HDA-200, Sennheiser HDA-300, Interacoustics DD-45, Holmco PD-81, GN ME-70, GN otoInsert, Etymotic Research ER-3A, JBL Control 2P (warble tone instead of sine)

f [Hz]	125	250	500	750	1000	1500	2000	3000	4000	5000	6000
HDA-280	60	70	70	70	70	70	70	70	70	70	70
HDA-200	60	70	70	70	70	70	70	70	70	70	70
HDA-300	60	70	70	70	70	70	70	70	70	70	70
DD-45	60	70	70	70	70	70	70	70	70	70	70
PD-81	60	70	70	70	70	70	70	70	70	70	70
ME-70	60	70	70	70	70	70	70	70	70	70	70
otoInsert	60	70	70	70	70	70	70	70	70	70	70
ER-3A	60	70	70	70	70	70	70	70	70	70	70
Control2P	---	---	70	---	70	---	70	70	70	---	---

Table 3: Maximum PTA class 4 sine stimulus levels for each transducer type

3.3 Pure-Tone Audiometry (PTA) Class 4 Extended

Screening audiometer class 4 according to IEC 60645-1 with extended frequency/level range

- Frequencies: 0.125, 0.25, 0.5, 0.75, 1, 1.5, 2, 3, 4, 5, 6, 8 kHz
- Stimulus levels: -10 to max. 110 dB HL or transducer limits (see *Table 4*), step size: 5 dB
- Stimulus type: sine

Available transducers: Sennheiser HDA-280, Sennheiser HDA-200, Sennheiser HDA-300, Interacoustics DD-45, Holmco PD-81, GN ME-70, GN otoInsert, Etymotic Research ER-3A, JBL Control 2P (warble tone instead of sine)

f [Hz]	125	250	500	750	1000	1500	2000	3000	4000	5000	6000	8000
HDA-280	60	80	110	110	110	110	110	110	110	100	95	90
HDA-200	60	80	100	105	105	100	100	105	100	95	95	90
HDA-300	60	80	110	110	110	110	110	110	105	100	95	95
DD-45	60	80	100	110	110	105	105	110	105	100	95	90
PD-81	60	80	110	110	110	110	110	110	105	100	100	100
ME-70	60	80	100	105	105	105	105	105	105	100	100	90
otoInsert	60	80	100	105	110	105	105	105	105	90	80	70
ER-3A *10Ω*	60	80	105	110	110	110	110	110	105	95	90	75
ER-3A *50Ω*	60	80	105	110	110	110	110	110	110	100	90	80
Control2P	---	---	80	---	80	---	80	80	70	---	---	---

Table 4: Maximum PTA class 4 extended sine stimulus levels for each transducer type

3.4 Pure-Tone Audiometry (PTA) Class 3

Audiometer class 3 according to IEC 60645-1

- Frequencies: 0.125, 0.25, 0.5, 0.75, 1, 1.5, 2, 3, 4, 5, 6, 8 kHz
- Stimulus levels: -10 to max. 110 dB HL or transducer limits (see *Table 5*), step size: 5 dB
- Stimulus types: sine, pulsed sine (f = 2.25 Hz), warble tone (sine modulation, modulation depth = 10 %, f_{mod} = 4 Hz)
- Masking noise (optional): third octave noise (see *Table 6* and *Table 7*)
- Auto PTA: Békésy (rate of level change: 5 dB/s), Hughson-Westlake (response window: start of stimulus+200 ms until end of stimulus), stimulus level limited to max. 80 dB HL, workflow according to ISO 8253-1, 6.2 and 6.3

Available transducers: Sennheiser HDA-280, Sennheiser HDA-200, Sennheiser HDA-300, Interacoustics DD-45, Holmco PD-81, GN ME-70, GN otoInsert, Etymotic Research ER-3A, RadioEar B-71, JBL Control 2P (warble tone; no sine, no pulsed sine, no masking noise, no Auto PTA)

f [Hz]	125	250	500	750	1000	1500	2000	3000	4000	5000	6000	8000
HDA-280	60	80	110	110	110	110	110	110	110	100	95	90
HDA-200	60	80	100	105	105	100	100	105	100	95	95	90
HDA-300	60	80	110	110	110	110	110	110	105	100	95	95
DD-45	60	80	100	110	110	105	105	110	105	100	95	90
PD-81	60	80	110	110	110	110	110	110	105	100	100	100

f [Hz]	125	250	500	750	1000	1500	2000	3000	4000	5000	6000	8000
ME-70	60	80	100	105	105	105	105	105	105	100	100	90
otoInsert	60	80	100	105	110	105	105	105	105	90	80	70
ER-3A *10Ω*	60	80	105	110	110	110	110	110	105	95	90	75
ER-3A *50Ω*	60	80	105	110	110	110	110	110	110	100	90	80
Control2P	---	---	80	---	80	---	80	80	70	---	---	---
B-71	---	35	50	55	60	60	60	60	50	45	40	35

Table 5: Maximum PTA class 3 sine stimulus levels for each transducer type

f_{center} *[Hz]*	125	250	500	750	1000	1500	2000	3000	4000	5000	6000	8000
f_L *[Hz]*	109	219	434	653	871	1307	1742	2613	3484	4353	5224	6965
f_U *[Hz]*	144	288	575	862	1149	1724	2299	3448	4597	5744	6893	9191

Table 6: PTA class 3 masking noise lower/upper frequency band limits

f [Hz]	125	250	500	750	1000	1500	2000	3000	4000	5000	6000	8000
HDA-280	50	65	80	80	80	80	80	80	80	70	70	70
HDA-200	50	70	80	80	80	80	80	80	80	70	70	70
HDA-300	50	70	80	80	80	80	80	80	80	70	70	70
DD-45	50	70	80	80	80	80	80	80	80	70	70	70
PD-81	50	70	80	80	80	80	80	80	80	70	70	70
ME-70	50	70	80	80	80	80	80	80	80	70	70	70
otoInsert	50	70	80	80	80	80	80	80	80	70	70	70
ER-3A	50	70	80	80	80	80	80	80	80	70	70	70

Table 7: Maximum PTA class 3 masking noise levels for each transducer type

3.5 Pure-Tone Audiometry at High Frequencies (PTA-HF)

Extends PTA module with additional frequencies: 9, 10, 11.2, 12.5, 14, 16 kHz

- Stimulus levels: -10 (PTA3/PTA4 Extended)/0 (PTA4) to max. 90 dB HL or transducer limits (see *Table 8*)
- Stimulus types: sine; PTA3 only: pulsed sine, warble tone
- Masking noise: third octave noise (see *Table 9* and *Table 10*)

Available transducers: Sennheiser HDA 200 / HDA-300

f [Hz]	9000	10000	11200	12500	14000	16000
HDA-200	90	85	80	70	70	55
HDA-300	80	90	80	70	70	60

Table 8: Maximum PTA-HF sine stimulus levels for each transducer type

f_{center} *[Hz]*	9000	10000	11200	12500	14000	16000
f_L *[Hz]*	7838	8710	9759	10899	12221	14010

f_{center} [Hz]	9000	10000	11200	12500	14000	16000
f_U [Hz]	10341	11491	12874	14376	16115	18461

Table 9: PTA-HF masking noise lower/upper band limits

f [Hz]	9000	10000	11200	12500	14000	16000
HDA-200	50	50	50	50	50	40
HDA-300	50	50	50	50	50	50

Table 10: Maximum PTA-HF masking noise levels for each transducer type

3.6 Speech Understanding in Noise (SUN)

Logatom-based speech test for children and adults

- Protocols:
  - Fixed level mode: constant speech level, adaptive noise level (SNR groups)
  - Adaptive level mode: adaptive speech level, constant noise level
- Speech level: 40 to max. 80 dB HL or transducer limits (see *Table 11*), step size: 5 dB
- Languages (pronunciations of logatoms): Italian, German; for validation: English, French, Spanish, Russian – additional languages upon request
- Character sets: Latin, Greek, Farsi, Hindi, Cyrillic, Czech (not all character sets are available for each language)

Available transducers: Sennheiser HDA-280, Sennheiser HDA-200, Sennheiser HDA-300, Interacoustics DD-45, Holmco PD-81, GN ME-70, GN otoInsert, Etymotic Research ER-3A, JBL Control 2P (free field loudspeaker calibration via CCITT noise)

Calibration type	IEC	ANSI
HDA-280	80	80
HDA-200	80	75
HDA-300	80	80
DD-45	80	80
PD-81	80	80
ME-70	80	80
otoInsert	80	70
ER-3A	80	75
Control 2P	80	70

Table 11: Maximum SUN speech levels for each transducer type

3.7 Mainzer Audiometric Test for Children (MATCH)

Image-based speech test for children from 2.5 years on

- Protocols:
  - Threshold estimation (speech recognition threshold) with adaptive algorithm; optional with ipsilateral noise

    - Discrimination loss estimation with fixed level; optional with ipsilateral noise
- Stimulus level: -10 to max. 100 dB or transducer limits (see *Table 12*), step size: 1 dB
- Options: ipsilateral masking with fixed level (65 dB), manual item selection
- Languages: German; for validation: English, French, Spanish, Russian, Turkish – additional languages upon request

Available transducers: Sennheiser HDA-280, Sennheiser HDA-200, Sennheiser HDA-300, Interacoustics DD-45, Holmco PD-81, GN ME-70, GN otoInsert, Etymotic Research ER-3A, JBL Control 2P (free field loudspeaker calibration via CCITT noise)

Calibration type	IEC	ANSI
HDA-280	100	85
HDA-200	90	80
HDA-300	100	85
DD-45	95	80
PD-81	100	90
ME-70	95	80
otoInsert	85	75
ER-3A	85	75
Control 2P	85	70

Table 12: Maximum MATCH speech levels (without ipsilateral noise) for each transducer type

3.8 Munich Auditory Screening Test for Processing Disorders (MAUS)

Screening test for auditory processing disorders for children from 6 to 11 years.

Copyright: Westra Elektroakustik GmbH 2003/2004. Details in separate MAUS manual. Authors: A. Nikisch, C. Heuckmann, T. Burger

Available transducers: Sennheiser HDA-280, Sennheiser HDA-200, Sennheiser HDA-300, Interacoustics DD-45, Holmco PD-81, GN ME-70, GN otoInsert, Etymotic Research ER-3A

3.9 Bochum Auditory Speech Discrimination Test (BASD)

Test for analyzing the central auditory function, including sub-tests for minimum audible difference of time, frequency, level, and the discrimination of syllables ba/ga and ga/ka (in validation).

Available transducers: Sennheiser HDA-280, Sennheiser HDA-200, Sennheiser HDA-300, Interacoustics DD-45, Holmco PD-81, GN ME-70, GN otoInsert, Etymotic Research ER-3A

3.10 Universal Speech Test (UST)

Word-based speech tests for children and adults.

- Speech level: 0 to max. 100 dB or transducer limits (see *Table 13*), step size: 5 dB
- Word lists: UT01: Dr. Tato (Spanish), UT02: Freiburger speech test (German) – additional word lists upon request

- Contralateral or ipsilateral noise (optional): fixed (0 to max. 100 dB), offset (-30 to +30 dB)
- Pre-test phases (optional): voice hearing, word understanding

Available transducers: Sennheiser HDA-280, Sennheiser HDA-200, Sennheiser HDA-300, Interacoustics DD-45, Holmco PD-81, GN ME-70, GN otoInsert, Etymotic Research ER-3A, JBL Control 2P (free field loudspeaker calibration via CCITT noise)

Calibration type	IEC	ANSI
HDA-280	100 (UST01: 100)	85 (UST01: 90)
HDA-200	90 (UST01: 95)	80 (UST01: 85)
HDA-300	100 (UST01: 100)	85 (UST01: 90)
DD-45	95 (UST01: 100)	80 (UST01: 85)
PD-81	100 (UST01: 100)	90 (UST01: 95)
ME-70	95 (UST01: 100)	80 (UST01: 85)
otoInsert	85 (UST01: 90)	75 (UST01: 80)
ER-3A	85 (UST01: 90)	75 (UST01: 80)
Control 2P	85 (UST01: 90)	70 (UST01: 75)

Table 13: Maximum UST speech levels (without ipsilateral noise) for each transducer type

3.11 Transient Evoked Otoacoustic Emissions (TEOAE)

- Modes: Quick, Diagnostic
- Noise detection: root mean square (RMS) of non-stimulus intervals
- Residual noise calculation: weighted averaging, summed weighting factors
- Artifact rejection: weighted averaging
- Response detection: 8 values with changing sign fulfilling a 3 sigma criterion (representing 99.7 % statistical significance)
- Calibration: in-the-ear calibration with ear-canal volume adjustment
- Sample rate: 48 kHz (stimulus), 16 kHz (response)
- Stimulus level: ca. 80 dB peSPL (peak equivalent)
- Stimulus type: nonlinear click (broadband 0.7 to 6 kHz)
- Statistical stop criterion (TEOAE Quick) or user-defined stop criterion (SNR: 3, 6, or 9 dB) in 3, 4, or 5 out of 5 frequency bands (1, 1.5, 2, 3, 4 kHz) (TEOAE Diagnostic)
- Window of analysis: 5 to 13 ms post-stimulus

Available transducers: PATH EP-TE, PATH EP-DP, PATH EP-VIP (Sentiero Desktop only), PATH EP-TY (Sentiero Desktop only)

3.12 Distortion Product Otoacoustic Emissions (DPOAE)

- Modes: Quick, Diagnostic, Threshold (for details see separate module sections for each mode)
- Noise detection: narrow band noise around $2f_2$-f_1
- Residual noise calculation: weighted averaging, summed weighting factors
- Artifact rejection: weighted averaging

- Response detection: F-test, F-value at a single point (F_{sp}) with critical value = 4
- Leakage detection: analysis of feedback signal (440 Hz probe tone)
- Sealing detection: limit of maximum pressure, comparison across speakers
- Calibration: in-the-ear calibration with ear-canal volume adjustment
- Sample rate: 48 kHz (stimulus, response)
- Measurement interval: 4096 samples
- Frequency ratio f_2/f_1: 1.22
- Stimulus modes (optional):
    - Frequency-modulated DPOAE (f_m = 1.4-1.6 Hz, modulation depth = 100 Hz at 4 kHz)
    - Multi-channel DPOAE (simultaneous measurement of DPOAEs at up to two f_2 frequencies at a time)

Available transducers: PATH EP-DP, PATH EP-VIP (Sentiero Desktop only), PATH EP-TY (Sentiero Desktop only)

3.12.1 DPOAE Quick/Diagnostic

- Frequencies f_2:
    - Standard: 1.5, 2, 3, 4, 5, 6, 8 kHz
    - Manual range selection:
        - Linear: 1 to 10 kHz (in steps of 0.5 kHz), step size: 10 to 1000 Hz (in steps of 10 Hz)
        - Logarithmic: 1 to 10 kHz (in steps of 0.5 kHz), step size: 1 to 30 points per octave (in steps of 1 point per octave)
- Stimulus levels L_2: 30 to 65 dB HL (in steps of 5 dB) (single and multiple selections possible)
- L_2/L_1 relation: automatic (scissor paradigm), $L_1=L_2$, $L_1=L_2+10$ dB
- Measurement time: adaptive timeout, manual minimum/maximum timeout (2 to 120 seconds)

3.12.2 DPOAE Threshold

- Frequencies f_2: 1.5, 2, 3, 4, 5, 6, 8 kHz
- Stimulus level L_2: 20 to 65 dB HL (automated threshold detection algorithm)
- L_2/L_1 relation: automatic (scissor paradigm)
- Features: automatic frequency and level optimization algorithm

3.13 Auditory Brainstem Reponses (ABR)

- Artifact rejection: weighted averaging, notch filter (50/60 Hz, self-tuning)
- Residual noise calculation: collecting noise energy from each frame, calculating residual noise level (absolute RMS value in nV)
- Response detection: auto peak-marker setting via correlation analysis
- Continuous monitoring of electrode impedance
- Normative latencies for different age groups
- Display and storage of waveform, impedance, residual noise, averages, peak marker (editable)

- Sample rate: 48 kHz (stimulus), 16 kHz (response)
- Stimulus type: Click (0 to 20 kHz), Chirp (broadband, 1 to 8 kHz), Low-Chirp (100 to 850 Hz), Mid-Chirp (850 Hz to 3 kHz), High-Chirp (3 to 10 kHz)
- Stimulus polarity: positive, negative, alternating
- Stimulus rate: 10, 20, 30, 40, 70, 80, 90 Hz
- Stimulus levels: 0 to max. 90 dB nHL or transducer limits (see *Table 14*), no stimulus; single or multiple selection of up to five levels per test sequence; step size: 5 dB
- Masking offset levels (white noise): -50 to +50 dB
- Averages: 1000 up to 20000, step size: 1000
- Noise stop criterion (optional): 20 to 80 nV, step size: 10 nV
- Plot range (fixed): 0 to inter-stimulus interval + 1.5 ms (minimum 10.5 ms, maximum: 15 ms)
- Additional parameters: Jitter, Auto Proceed, Auto Stop

Available transducers: Sennheiser HDA-280, Sennheiser HDA-200, Sennheiser HDA-300, Interacoustics DD-45, Holmco PD-81, GN ME-70, GN otoInsert, Etymotic Research ER-3A, PATH EP-DP, PATH EP-VIP (Sentiero Desktop only), PATH EP-TY (Sentiero Desktop only), RadioEar B-71

Stim.type	**Click**	**Chirp**	**Low-Chirp**	**Mid-Chirp**	**High-Chirp**
HDA-280	85	90	90	90	85
HDA-200	80	85	85	85	80
HDA-300	85	90	90	90	85
DD-45	85	90	85	90	85
PD-81	85	90	90	90	80
ME-70	80	85	85	85	85
otoInsert	80	85	85	90	75
ER-3A *10Ω*	85	90	85	90	80
ER-3A *50Ω*	85	90	90	90	80
EP-DP *	75 80	80 85	65 70	80 85	75 80
EP-VIP, -TY *	85 90	90 90	75 80	90 90	90 90
B-71	65	65	65	70	60
* First row: 2cc test cavity, second row: example adult ear. Dependent on ear canal volume, the actual level may be lower (big ear canal volume) or higher (small ear canal volume).					

Table 14: Maximum ABR stimulus levels for each transducer type

3.14 Auditory Steady-State Responses (ASSR)

- Protocols:
  - Adaptive level procedure (threshold estimation)
  - Fixed level procedure
- Stimulus rate: 40 Hz (multi-frequency: 40 to 42 Hz) and 80 Hz (multi-frequency: 82 to 84 Hz)
- Stimulus level (fixed mode): 10 to max. 100 dB HL or transducer limits (see *Table 15*); single or multiple level selections possible, step size: 10 dB

- Stimulus level (adaptive mode): 0 to max. 100 dB HL or transducer limits (see *Table 15*), step size: 10 dB
- Frequencies: 0.25, 0.5, 1, 1.5, 2, 3, 4, 6 kHz
- Additional parameters: number of averages (45 to 900 s in steps of 15 s), 4 frequencies per ear (40 Hz), significance level (fixed to 5 %)
- Display and storage of waveform, impedance, artifact threshold, modulation frequency

Available transducers: Sennheiser HDA-280, Sennheiser HDA-200, Sennheiser HDA-300, Interacoustics DD-45, Holmco PD-81, GN ME-70, GN otoInsert, Etymotic Research ER-3A, PATH EP-DP, PATH EP-VIP (Sentiero Desktop only), PATH EP-TY (Sentiero Desktop only)

f [Hz]	**250**	**500**	**1000**	**1500**	**2000**	**3000**	**4000**	**6000**
HDA-280	100	100	100	100	100	100	90	80
HDA-200	90	90	90	90	90	90	80	80
HDA-300	100	100	100	90	100	100	90	80
DD-45	80	90	90	90	100	100	90	90
PD-81	100	100	100	100	100	100	90	90
ME-70	80	90	90	90	90	100	90	100
otoInsert	90	90	90	90	100	90	90	70
ER-3A	90	90	90	100	100	100	90	80
EP-DP*	60 70	70 80	70 80	70 80	80 90	90 90	80 90	80 80
EP-VIP, -TY*	80 80	80 90	80 90	90 100	90 100	100 100	90 100	90 100
* First row: 2cc test cavity, second row: example adult ear. Dependent on ear canal volume, the actual level may be lower (big ear canal volume) or higher (small ear canal volume).								

Table 15: Maximum ASSR stimulus levels for each transducer type (single frequency measurement only – simultaneous measurement at multiple frequencies may reduce the maximum stimulus level).

3.15 Middle Ear Tests

- Probe tone: 226 Hz ±1 % at 85.3 dB SPL ± 3 dB

Available transducers: PATH EP-TY (Sentiero Desktop only)

3.15.1 Tympanometry

- Additional probe tones: 678 Hz ± 1 % at 72 dB SPL ± 3 dB, 800 Hz ± 1 % at 70.6 dB SPL ± 3 dB, 1000 Hz ± 1 % at 69 dB SPL ± 3 dB
- Compliance Range: 0 to 5 ml
- Compliance Accuracy : ±5 % or 0.1 ml (whichever is greater)
- Pressure Range: +300 to -300 daPa (normal range), +400 to -600 daPa (extended range); minimum: -600 to 100 daPa, maximum: +200 to +400 daPa, step size: 50 daPa
- Pressure Accuracy: ±10 % or 10 daPa (whichever is greater)
- Pump speed: 50, 100, 150, 200 daPa/s ± 10 daPa/s, as fast as possible

3.15.2 Acoustic Reflex

- Modes: manual, automatic, decay
- Stimulus presentation modes: ipsilateral, contralateral (if 2nd transducer is connected)
- Pressure offset: taken over from tympanometry measurement, editable: see section *3.15.1: Tympanometry* (pressure range)
- Acoustic reflex stimuli (using EP-TY probe): 500, 1000, 2000, 4000 Hz, up to 105 dB HL (100 for 500 Hz); Broadband noise (CCITT) up to 90 dB HL
- Acoustic reflex stimulus duration: 2 s, 14 s for reflex decay
- Acoustic reflex stimulus signal time multiplexed with probe tone (106 ms on, 53 ms off)

Available transducers for contralateral reflex: Sennheiser HDA-280, Sennheiser HDA-200, Sennheiser HDA-300, Interacoustics DD-45, Holmco PD-81, GN ME-70, GN otoInsert, Etymotic Research ER-3A, PATH EP-VIP (Sentiero Desktop only)

3.15.3 Eustachian Tube Function Tests

- Modes: non-perforated ear drum, perforated ear drum, patulous eustachian tube

4. Accessories

Accessories (e.g. headphones, insert earphones, electrode cables, electrodes, label printer) may include separate manuals and/or data sheets which may contain important information. Please refer to these documents for further information about the respective accessory.

Contact information from distributor/service partner:

Made in Germany

PATH medical GmbH
Landsberger Straße 63
82110 Germering
Germany

Tel.: +49 89 800 765 02 Fax: +49 89 800 765 03 Internet: www.pathme.de

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